

## **10.4 Manufacturing Process**

The realization of the design during the manufacturing process is where the fracture control plan reaches its ultimate test. It is now that a diverse group of participants must be brought into control to insure the production of the required quality.

Each manufacturing step of the fracture critical parts must be monitored and controlled. Procedures must be developed which provide strict accountability and sign-off from step to step but which also do not unduly hinder the normal flow of manufacturing processes. Two major items are involved at this point: (1) establishing the control of manufacturing quality, and (2) developing the methods for critical parts accountability.

### **10.4.1 Control of Quality of Processes**

Three major items comprise the function of the manufacturing process quality control. They are:

- (1) Definition of inspection requirements
- (2) Demonstration of inspection methods
- (3) Review of manufacturing process and inspections

The basic document for the manufacture of each fracture critical part is the process specification. It lists all of the processes that must be performed on the part. This forms the basis for selection of the inspection methods. Limits for acceptance are also a part of the process specification. The scheduling of inspections during the process must be considered. A trade-off between inspection cost, rework cost, and loss due to scrap must be made. This process may be more critical in a fracture critical part than in another part since there may not be as many rework options open. Thus, it may be more efficient to have more inspections than to risk losing a large amount of process time. Parts that do not pass an early inspection may be reclaimed through rework options still available at this time.

The demonstration of the efficiency of nondestructive process inspections can be made through destructive testing or through a more rigorous nondestructive inspection. This demonstration is made early in the program and may be subject to periodic checking over the life of the project. As experience is gained with the process, the inspection frequency may be decreased.

It should be noted that whenever either new process equipment is installed or inspection equipment is changed, the inspection procedure should be tightened until confidence is again attained. This also should include periodic review of the inspection process to insure that the quality of the inspection is being maintained.

### **10.4.2 Development of Critical Parts Accountability**

The critical parts list is only the first step in the control process. It also includes the damage review procedure, material procurement and acceptance, handling of the part during manufacture, installation procedures, incorporation of design changes, and disposition of manufactured parts. This entire process is one of accountability. In order to do this, a method of serial numbering is used and a work routing sheet is suggested which identifies the source of the stock material used in the part during its manufacture and provides sign-off and transfer records for each process. In order for this process of control to be effective, the personnel involved during manufacture must have an awareness of the objective. They must realize the development of an individual commitment to achieve a damage tolerant aircraft. Goranson, et al. [1981] and Watson [1979]

present discussions of how damage tolerant design has been incorporated into transport aircraft design and construction.